Eliminating inappropriate antibiotic use

Building a data-driven rapid diagnostic

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AMR now
700,000
(low estimate)

AMR in 2050
10 million

- Tetanus
  60,000
- Road traffic accidents
  1.2 million
- Cancer
  8.2 million
- Measles
  130,000
- Cholera
  100,000–120,000
- Diarrhoeal disease
  1.4 million
- Diabetes
  1.5 million
Antimicrobials are rapidly becoming less effective.
To tackle AMR, we need to...

Reduce demand for antimicrobials
Inappropriate use of antibiotics is high – up to 67%
Prescribing as in 1950s
Needs to be done safely

Increase supply of new antimicrobials
No new class for 30 years
Broken market
Resistance will always occur
Where do we start?

Antibiotic use by care setting in England, 2014

- General practice: 74%
- Hospital inpatients: 11%
- Hospital outpatients: 7%
- Dental practices: 5%
- Other community settings: 3%


Better IT adoption
Lower acuity patients
No onsite labs/clinical microbiologists
Widespread call for rapid diagnostics

The Pharmaceutical Journal

Government review says antibiotics should not be prescribed without rapid diagnostic test

Report says developed countries should lead the way and build rapid testing to tackle antimicrobial resistance

BBC News

Rapid tests 'would cut antibiotic use'

Rapid diagnostic tests are urgently needed to help doctors know which patients need antibiotics, a report says.

The Telegraph

Two thirds of antibiotics are needlessly prescribed, a report warns

Economist Jim O'Neill has published a report which calls for more diagnostic procedures to help GPs avoid unnecessary prescriptions.

The Guardian

No antibiotics without a test, says report on rising antimicrobial resistance

Report by economist Jim O’Neill says global cost of problem could be loss of 10 million lives a year by 2050 and $10tn a year

PharmaTimes

Rapid diagnostic tools needed to fix antibiotic crisis, says review

Government paper says fundamental change is ‘essential’ to stop antibiotics being prescribed unnecessarily

Nature

A Faster Way to Diagnose Antibiotic Resistance

Novel test could slash wait time and curb inappropriate prescriptions
Software will beat (and support) hardware

Cost
Hardware costs more than generic antibiotics.
Software can be delivered at zero marginal cost.

Adoption
Hardware requires separate devices, maintenance and consumables.
Can’t be integrated in the workflow and can’t provide a definitive diagnosis.

Technology
Suitable hardware diagnostics don’t yet exist.
High requirements for speed, scalability, accuracy and ease-of-use.
Drivers of overprescribing

**Patient Expectation**
- Expect active treatment
- Want a safety net
- Poor public awareness

**Clinician Confidence**
- Large degree of uncertainty
- Unbalanced risks
- Lack of feedback

**Time Constraint**
- Little time to educate
- No time for POC tests
- Minimal capacity for repeat appointments/follow-up
We’re combining three methodologies

**Decision support**
Enabling complex empirical decisions whilst maintaining clinical freedom

**Behavioral nudges**
Influencing decisions at the right point and in the right way whilst helping clinicians meet patient expectations

**Data science**
Synthesizing existing and new data sources to allow self-learning treatment decisions
Prescribed antibiotic items by Clinical Commissioning Group

2.25x variation
Medical history

Presenting symptoms

Treatment given

Clinical outcome

accuRx. dataset

Optimise for outcomes
Prescribing Accuracy

Volume of consultations

Illness severity

Necessary prescriptions
accuRx. Chain

Decision support based on existing guidelines, integrated into the workflow.

To gain adoption and gather structured data.

accuRx. Florey

Remote SMS management to offer an alternative to antibiotics and provide a safety net.

To gather outcomes and adapt the workflow.

accuRx. Fleming

Data-driven rapid diagnostic that is patient-specific and self-learning.

To eliminate inappropriate antibiotic use.
accuRx Chain

Patient advice:
Hi Joe, here is a link to guidelines for management of your Sore Throat - Acute: accuRx.me/app/guidelines/1014

Smart formulary:

Good afternoon, Joe.

Below you will find guidelines for management of your infection (Sore Throat - Acute).

Take ibuprofen or paracetamol - paracetamol is better for children and for people who can’t take ibuprofen (note that children under 18 should never take aspirin)

Drink plenty of cool or warm fluids, and avoid very hot drinks

Eat cool, soft foods

Avoid smoking and smoky places
Active Management
Meeting patient expectations for active treatment without prescribing, whilst providing GPs with a safety net

Course Adherence Nudges
Engaging patients in the management of infection and improved medication compliance

Smart Delayed Prescribing
Delaying the decision point to prescribe and unlocking prescriptions on logic chosen in the consultation e.g. patient reported symptoms or lab results

Outcomes Collection
Collecting an unbiased set of patient-reported outcomes, linked to their consultation information
Outcomes Collection

Inputs
- Education
- Guidelines
- Pt expectations
- Past experience

Process
Consultation

Outputs
- Rx
- No Rx

Outcomes
- Good outcome
- Bad outcome

Recall bias: A&E attendances, complaints, repeat consultations
Balancing the feedback loop
GP benefits: Operational support

- Time saving
- Skill mix support
- Improved prescribing
- Improved patient safety
- Improved patient experience
- Improved audit trail
Challenges

• Converting political priorities to local ones
• Lack of market or incentives
• Focus on diagnostics
• Iterating in healthcare
• Getting into the workflow
• Focus!
• Guideline limitations
Each datapoint is a timeline of events

<table>
<thead>
<tr>
<th>History</th>
<th>Presentation</th>
<th>Treatment</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical history</td>
<td>Symptoms</td>
<td>Medication</td>
<td>Time until symptom-free</td>
</tr>
<tr>
<td>Social history</td>
<td>Examinations</td>
<td>Procedures</td>
<td>Complications</td>
</tr>
<tr>
<td>Family history</td>
<td>Investigations</td>
<td>Self-care</td>
<td>Impact on Quality of Life</td>
</tr>
</tbody>
</table>

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Data availability is limited and quality is low

Key data stored in medical record
Incomplete information, mostly free text, entered during consultation
Information not seen by clinicians, hence not captured
We collect this data

- From API with medical record
- Within the existing workflow
- Using dynamic templates
- From SMS messages from patient/carer
- By linking system-reported outcomes
Latent Variable Modeling: PCA

original data space

PCA

component space

Gene 3

Gene 2

Gene 1

PC 1

PC 2

PC 1

PC 2